

**BENEFIT-COST DETERMINATION:**  
**CHOLINESTERASE MONITORING IN AGRICULTURE**  
**WAC 296-307-148**  
**WASHINGTON STATE DEPARTMENT OF LABOR AND INDUSTRIES**  
**December 2, 2003**

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## **EXECUTIVE SUMMARY**

In this document, prepared in compliance with the Administrative Procedure Act (APA), the Department of Labor and Industries (L&I) has assessed both the probable benefits of the cholinesterase monitoring rule and its probable costs.

This assessment represents a unique challenge. Although the compliance costs of the rule can be estimated in quantitative terms with some degree of confidence, the benefits are less susceptible to such quantitative analysis.

L&I has identified a range of benefits, primary among them being the protection of worker health and prevention of serious illness, as well as the increased knowledge and more reliable information that the monitoring and recordkeeping provisions of the rule would themselves generate.

L&I has then balanced these benefits against the costs of the rule, estimated to be \$858 thousand in the first year and \$1.3 million beginning in the second year.<sup>1</sup> Table 1 includes this central estimate, as well as the high and low estimates for the same period.<sup>2</sup>

<b>Table 1: Estimated Compliance Costs</b>			
	<b>Central</b>	<b>High</b>	<b>Low</b>
<b>First Year</b>	\$858,490	\$1,159,349	\$688,668
<b>Second Year</b>	\$1,274,487	\$1,730,364	\$1,096,165

After considering the statutory mandates of the Washington Industrial Safety and Health Act (WISHA), the guidance provided by the state Supreme Court in the *Rios et al v. L&I et al* decision that prompted the rulemaking, and the best available evidence in the rulemaking record, L&I has determined that the probable benefits of the rule outweigh its probable costs for each of the three scenarios. L&I made this determination on a preliminary basis in its draft Benefit-Cost Determination, circulated for public comment ending October 31, 2003. The final determination, reflected by the document, is strengthened by the reduction in estimated compliance costs based on the most current information.

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<sup>1</sup> Throughout this analysis, dollar values for future years are presented in current dollars, without adjustment or discounting.

<sup>2</sup> A comparison with the numbers provided in the Review Draft of the Benefit-Cost Determination provided for public comment will reveal that the current numbers, particularly for the second year and beyond, are noticeably lower; the bulk of the change is the result of more reliable figures for laboratory analysis, as discussed on page 19.

## **SECTION 1: BACKGROUND INFORMATION**

This analysis evaluates the probable benefits and probable costs of the cholinesterase-monitoring rule (WAC 296-307-148), as required by the Administrative Procedure Act<sup>3</sup>.

In the context of this analysis and unless clearly used otherwise, “pesticide” refers to toxicity category I or II organophosphate or N-methyl-carbamate cholinesterase-inhibiting pesticides and “handler” refers to any employee who is a pesticide handler as defined in the agriculture Worker Protection Standard<sup>4</sup> and who is handling covered pesticides.

### **Previous Regulatory Activity**

In 1993, after evaluating the feasibility and benefits of cholinesterase monitoring, coupled with the protections then being adopted as part of the pesticide Worker Protection Standard, the Washington State Department of Labor & Industries (L&I) recommended cholinesterase monitoring in agriculture (WAC 296-307-14520). The recommendation included baseline and periodic red blood cell (RBC) and plasma cholinesterase testing for workers handling organophosphate or N-methyl-carbamate pesticides for 30 or more hours in any 30-day period.

In 1997, L&I was asked to implement mandatory cholinesterase monitoring. L&I declined to do so, based on a consideration of available L&I resources and agency priorities. L&I did not, however, decide that a rule was not warranted. L&I’s decision not to pursue rulemaking at the time led to legal action to require L&I to act. In 2002, the Supreme Court of the State of Washington in *Rios*<sup>5</sup> upheld the 1993 decision to adopt a recommendation, but required L&I to initiate rulemaking in response to the 1997 request.

To assist in the development of a rule proposal, L&I formed an advisory group consisting of agriculture worker representatives, growers, other government agencies, and scientific community representatives. L&I also conducted public data-gathering meetings around the state. Both the public meetings and the grower associations participating on the advisory group included representatives of small businesses that would be affected by the rule.

Because no benefit-cost determination was included with the original proposal, L&I decided to provide a review draft of this document for additional public comment after the comment period on the rule itself had ended. Those comments were considered, responded to as part of the public record, and reflected in this final benefit-cost determination as appropriate.

### **Cholinesterase-Inhibiting Pesticides**

Organophosphate and N-methyl-carbamate pesticides inhibit the activity of the enzyme acetylcholinesterase (AChE). AChE aids in regulation of the nervous system by removing the neurotransmitter acetylcholine from neuronal junctions and target receptor sites (for example, a muscle or gland). Exposure to these pesticides can lead to an accumulation of acetylcholine, which in turn could result in the over-stimulation of an individual’s nervous system. Common symptoms of such cholinergic poisoning include increased sweating, blurred vision, diarrhea, tremors and malaise. Severe exposures may result in pulmonary edema, respiratory distress, seizures, loss of consciousness, and death.

Organophosphate and N-methyl-carbamate pesticides share a common mechanism of toxicity. Both bind with AChE and prevent destruction of acetylcholine. The major difference between

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<sup>3</sup> RCW 34.05.328(1)(c)

<sup>4</sup> WAC 296-307-107 *et seq.*, also known as Chapter 296-307, Part I

<sup>5</sup> *Juan Rios and Juan Farias v. Washington Department of Labor & Industries, et al.*, 145 Wn.2d 483, 39 P.3d 961 (2002).

organophosphate and N-methyl-carbamate pesticides is that the phosphate bond persists for days and may become permanent, while the carbamate bond may last for as little as 30 minutes to 24 hours. In general, regeneration (replacement) of permanently bound AChE is measured at the rate that AChE is synthesized in the blood stream (approximately 1 percent per day.)

While inhibition of AChE by organophosphate pesticides lasts much longer than the effects of N-methyl-carbamate pesticides, the physiologic consequences are the same. Overlapping exposures to the two categories of pesticides can result in an accumulation of toxic effects.

Symptoms of poisoning are often self-limited, with normal function returning when exposure is eliminated, as bound AChE regenerates and new enzyme is synthesized in the body.

### **Cholinesterase Monitoring**

Accepted methods of cholinesterase monitoring involve measuring the activity of both red blood cell (RBC) and plasma cholinesterase. Both enzymes have been shown to act as surrogates for AChE activity in the nervous system. RBC cholinesterase is the same AChE found in the nervous system and is thought to better reflect effects on nervous system AChE than plasma cholinesterase. However, because plasma testing can provide useful additional information, monitoring both RBC and plasma cholinesterase enzymes provides a more complete clinical picture of exposure to covered pesticides.

Exposure to cholinesterase-inhibiting pesticides also can be evaluated by direct measurement of pesticide in the blood or by measuring pesticide metabolites in the urine. Both methods present problems that make them less desirable monitoring methods. Urine metabolites begin being secreted in the urine almost immediately and may disappear within 48-72 hours. Detection of pesticides in the blood requires specific laboratory assays for each pesticide, thus requiring many different analytical methods. In addition, while both methods detect pesticide exposure, neither provides information on worker's physiologic response. Given the limitations of other methods, measurement of blood cholinesterase levels provides the most practical and efficient method for monitoring cholinesterase activity and identifying possible overexposures. However, the limitations of this method require that certain practical considerations be addressed.

Blood cholinesterase measurement is subject to intra- and interpersonal variability. Because of expected intrapersonal variability, the rule does not require a response until a meaningful reduction has been identified. Because of inter-personal variability, there is no "normal" cholinesterase level. This means that effective monitoring depends upon a periodic comparison of an individual's cholinesterase levels to a personal baseline value established for that individual prior to exposure.

Several laboratory methods for measuring cholinesterase activity levels are available. Of these, the electrometric and colorimetric methods are most often used. Both methods are effective for RBC and plasma cholinesterase testing. Because these methods use different systems to report results it is difficult to compare tests between methodologies. Even though conversion equations exist to compare different reporting systems, these equations are not always reliable. For this reason, the rule requires that medical providers send samples to a laboratory approved by L&I, which will analyze each individual's baseline and periodic tests, using a consistent method.

The rule is part of the Agriculture Standard adopted under WISHA<sup>6</sup> and, as such, applies to all agricultural activity in the state where covered pesticides are used.

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<sup>6</sup> "Safety Standards for Agriculture," Chapter 296-307 of the Washington Administrative Code (WAC).

### **Summary of the Rule**

The final rule includes the following provisions:

1. The employer will be required to keep records of all employee handling of covered pesticides, and retain those records for seven years.
2. Cholinesterase monitoring (RBC and plasma cholinesterase) will be required for employees who handle covered pesticides for 50 or more hours in any consecutive 30-day period beginning January 15, 2004, and for 30 or more hours in any consecutive 30-day period beginning January 15, 2005.
3. Employers will be required to ensure that employees requiring medical monitoring will receive training that includes at a minimum:
  - The human health hazards associated with exposure to organophosphate and N-methyl-carbamate pesticides
  - The purpose and requirements of cholinesterase monitoring.
4. Employers will identify a medical provider to provide (at no cost to the employee, and at a reasonable time and place) baseline and periodic testing, interpretation of test results, and recommendations resulting from those test results
5. Employees may choose to decline cholinesterase testing after receiving training and consulting with the medical provider.
6. Pre-exposure baseline testing will be conducted annually.
7. Employers whose employees who handle only N-methyl-carbamate pesticides will be exempt from the requirement to offer those employees cholinesterase testing.
8. Hours spent mixing and loading using closed systems (as described in WAC 296-307-13045(4)(d)) will not be counted as exposure hours for the purposes of periodic monitoring beyond the baseline.
9. Periodic testing will be required within 3 days of meeting the designated exposure thresholds *or* at least every 30 days while exposure is expected to exceed thresholds.
10. Cholinesterase depressions will require the following employer actions:
  - A depression of 20% or more from the employee's personal baseline will require the employer to conduct a work practice investigation
  - An RBC cholinesterase depression of 30% or more from the personal baseline or a plasma cholinesterase depression of 40% or more from the personal baseline will require the employee to be temporarily removed from organophosphate and N-methyl-carbamate exposure and the employer to conduct a work practice investigation.
  - An employee removed from exposure will not be allowed to return to handling covered pesticides or participate in other exposure-prone activities until his or her cholinesterase levels are within 20 percent of the personal baseline.
11. Medical removal protection until return to normal duties (not to exceed 3 months) will be made available to employees removed from handling due to cholinesterase depression.
12. The employer must maintain (or contract with the provider to maintain) monitoring and related medical records for 7 years.
13. The thresholds in the rule will be evaluated by L&I (in consultation with both a scientific panel and a stakeholder advisory group) before the 30-hour threshold takes effect, and again before the third year of the rule's existence. L&I will propose changes to the rule if appropriate based on this evaluation.

## **Section 2: Probable Benefits of the Rule**

The rule is expected to provide a number of benefits, and some quantitative information is available for certain benefits – such as the number of workers likely to be identified and treated for cholinesterase depression as a result of the rule. However, available information about most of these benefits makes it impracticable to quantify them with a high level of confidence.

In some cases – such as the value of increased knowledge and the preeminent value of protecting worker health – the benefits are essentially qualitative.<sup>7</sup> In other cases – such as the number of pesticide poisonings prevented – the benefits presumably can be quantified when more precise statistical information is available. Indeed, the development of such information is itself one of the rule's benefits. In still other cases – such as the degree to which the presence of medical monitoring and medical removal protection prompts better enforcement of existing work rules and use of personal protective equipment – the information provided by the rule is not likely to provide quantitative certainty.

In all these cases, however, L&I must take the probable benefits into account, even when they cannot readily be quantified with information presently in the record.

### **Prevention of Serious Illness After Over-Exposure**

L&I has estimated that medical monitoring will identify cholinesterase depressions requiring medical removal in between 1.2 and 4.8 percent of participating employees, with a central estimate of 3 percent. If 85 percent of eligible employees participate in the medical monitoring, the central estimate suggests that the rule will identify 37 employees with depressed cholinesterase levels in the first year, and 95 beginning in the second year.

Some testimony in the record has suggested that the percentage of employees identified could be as high as 25 percent, which would mean 310 employees would be identified in the first year and 795 in the second year. However, L&I has concluded that this estimate is unrealistically high. Similarly, the record contains testimony arguing that the appropriate removal rate would be less than one percent – a one percent rate would mean 12 employees in the first year and 32 employees in the second year. Again, L&I has concluded that the appropriate lower bound is 1.2 percent and that the available evidence suggests it is unrealistic to expect a removal rate approaching zero percent.

Employees removed from exposure before serious illness occurs will be likely to experience a number of benefits, the most obvious of which is avoidance of serious illness and the resulting effects on both economic productivity and social interaction. The toxic effects of cholinesterase-inhibiting pesticides are well documented.<sup>8,9</sup> In addition to the well-documented and widely accepted short-term health effects of overexposure to covered pesticides, the record also suggests that avoiding ongoing over-exposures may reduce the risk of permanent harm to the nervous

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<sup>7</sup> The department recognizes that methods exist to assign quantitative meaning to even inherently qualitative benefits, such as the value of life, although such methods are based on a variety of methodologies and assumptions; however, the Administrative Procedure Act explicitly references both “quantitative” and “qualitative” analysis, making the use of such statistical tools unnecessary.

<sup>8</sup> Krieger, R.I. (2001). Handbook of Pesticide Toxicology. Academic Press, Inc., New York, NY.

<sup>9</sup> Lessenger, J.E. & Reese, R.E (2000). The Pathophysiology of Acetylcholinesterase Inhibiting Pesticides. Journal of Agromedicine. Vol. 7(2), 5-19.

system.<sup>10</sup> Indeed, in 1992 the EPA concluded that acute poisonings could lead to “systemic illnesses” that may exist “for months or years after the initial exposure.”<sup>11</sup>

The rule would prevent short, intermediate, and long-term adverse effects from chronic exposure. The rule would result in reporting of currently undiagnosed chronic exposure that is likely to be untreated and could result in a pesticide poisoning. Several long-term effects of acute and chronic exposure to cholinesterase-inhibiting pesticides have been identified. Intermediate syndrome occurs following acute exposures, with potential symptoms including severe muscle weakness and respiratory paralysis. Intermediate syndrome is a collection of symptoms that generally occur 24-96 hours after exposure to ChE-inhibitors and prior to the development of Organophosphate-induced delayed neuropathy (OPIDN). OPIDN results in weakness or paralysis of the extremities. The effects of OPIDN can last for months to years.<sup>12, 13</sup> Research has strengthened the relationship between exposure to cholinesterase-inhibiting compounds and central nervous system health effects including impairments in concentration, memory, language, and personality.<sup>14, 15</sup> Although some information in the record suggests that OPIDN is not likely to occur for pesticides licensed for use in the state, the department has concluded that the risk remains real (especially in the event that personal protective equipment (PPE) or engineering controls are used inconsistently over an extended period of time.

It is difficult to identify illnesses resulting from chronic exposure using traditional methods. The EPA concluded in its own rulemaking related to pesticides that “many incidents of *acute* and allergic pesticide effects on agricultural workers and pesticide handlers are not diagnosed as such by a physician.”<sup>16</sup> In reviewing the data available on the subject in 1992, the EPA made the following observation:

There is considerable uncertainty about the number of such incidents. The available studies which address this issue often suffer from a number of limitations, including reliance on recall of workers that may be affected by the questions asked, samples that are small or that may not be representative, etc. Nonetheless, the Agency believes that, with all their weaknesses with respect to this objective, *existing studies, taken together, are remarkably consistent with a conclusion that undiagnosed cases of pesticide poisoning incidents among the agricultural work force subject to the WPS are likely to be significantly more numerous than those that are diagnosed.*<sup>17</sup>

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<sup>10</sup> Such risks are suggested by references in the record to articles such as the following: Ray, David and Richards, P.G., “The Potential for Toxic Effects of Chronic, Low-Dose Exposure to Organophosphates,” *120 Toxicological Letters* 343-351 (2001); Peiris-John, Roshini, *et al*, “Effects of Occupational Exposure to Organophosphate Pesticides on Nerve and Neuromuscular Function,” *44 J. Occupational Environmental Medicine* 4 (2002); Jamal, Goran, *et al*, “Low Level Exposures to Organophosphorus Esters May Cause Neurotoxicity,” *181-182 Toxicology* 23-33 (2002).

<sup>11</sup> *Regulatory Impact Analysis of Worker Protection Standard for Agricultural Pesticides*, Biological and Economic Analysis Division, Office of Pesticide Programs, United States Environmental Protection Agency, August 1992, pp. V-28-29.

<sup>12</sup> Environmental Protection Agency (1999). *Recognition and Management of Pesticide Poisonings*, 5th ed. Environmental Protection Agency, Washington D.C.

<sup>13</sup> Keifer, M.C. & Mahurn, R.K. (1997). *Chronic Neurological Effects of Pesticide Overexposure*. Occupational Medicine: State of the Art Reviews. Hanley 7 Belfus, Inc. Philadelphia, PA.

<sup>14</sup> *Ibid*.

<sup>15</sup> Savage, E.P., Thomas, K.J., Mounce, L.M., Heaton, R.K., Lewis, J.A., & Burcar, P.J. (1988). Chronic Neurological Sequelae of Acute Organophosphate Pesticide Poisoning. *Archives of Environmental Health*. Vol. 43(1). 38-45.

<sup>16</sup> *Ibid*, p. V-17.

<sup>17</sup> *Ibid*, p. V-17, emphasis added.

After discussing the expected benefits of its own rulemaking, the EPA declined to estimate how many such cases were occurring and might be avoided by compliance with the rule, observing only that “the Agency believes the number is very likely to be large.”<sup>18</sup>

These problems in identifying cases of occupational disease have long been recognized as a limitation in using workers compensation, Bureau of Labor Statistics, and other data sources to indicate the extent of such illness.<sup>19</sup>

Pesticide poisoning is commonly under-diagnosed and under-reported.<sup>20, 21</sup> Cholinergic poisoning has clinical symptoms that are common to a variety of medical conditions. In general, mild cholinergic poisoning mimics symptoms of the common cold or environmental allergies. A Washington state study found that more than 11 percent of agricultural pesticide handlers had ChE depressions levels at the end of the application season consistent with proposed work practice evaluation trigger levels. Even after eliminating the less reliable measurements for plasma cholinesterase, the study found 5.6 percent with depressions that would trigger an investigation of work practices under the rule and 1.85 percent with depressions that would trigger medical removal under the rule (this in spite of reported use of various forms of PPE).<sup>22</sup> A 2001 focus group study conducted by the Washington State Department of Health (DOH) found that 75% of the participating farm workers reported experiencing symptoms of pesticide illness, although it is unknown from the study how many of these were handlers. These included headache, eye irritation, difficulty breathing, and nausea. However, most did not seek medical care for these conditions.<sup>23</sup> These results, now available from DOH in summary form,<sup>24</sup> support the conclusion that a large number of pesticide illnesses in farm workers are never identified.

Although this analysis and the many studies that preceded it may each be individually challenged in certain respects, the EPA’s conclusion of more than a decade ago remains true today: Taken together, existing studies and analyses – as well as anecdotal information – are consistent in their suggestion that pesticide illnesses in agriculture continue to be under-reported to a significant degree.

Given this background, and an awareness of the inherent limitations of training and use of personal protective equipment in protecting employees, it remains reasonable to assume that there is some meaningful group of employees in Washington agriculture who not only are becoming ill because of organophosphate and N-methyl-carbamate exposures, but also are doing so without knowing it. The three percent central estimate of depressed cholinesterase levels used by L&I is a reasonable estimate of these exposures, based on the best available information.

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<sup>18</sup> *Ibid*, p. V-33.

<sup>19</sup> See, for example, Pollack, Earl S. and Deborah Gellerman Keimig, *et al*, *Counting Injuries and Illnesses in the Workplace: Proposals for a Better System*, National Research Council, National Academy Press, 1987, pp. 5, 80-100; and *An Interim Report to Congress on Occupational Diseases*, United States Department of Labor, 1980, pp. 1,3

<sup>20</sup> Environmental Protection Agency (1999). *Recognition and Management of Pesticide Poisonings*, 5th ed. Environmental Protection Agency, Washington D.C.

<sup>21</sup> Washington State Department of Health. Pesticide Incident Report Data. Pesticide Incident Reporting and Tracking Review Panel.

<sup>22</sup> Karr, C., Keifer, M., & Miller M. & Kaufman, J. (1998). “Field Based Monitoring of Agricultural Workers for Overexposure to Cholinesterase-inhibiting Pesticides: Evaluation of an Experimental Program.” *Journal of Agromedicine*, Vol. 5(4) 1998.

<sup>23</sup> Vanderslice, J, Baum, L., Bardin, J, Bonnar-Prado, J, & Hanks C. (2001). *Learning from Listening: Results of Farmworker Focus Groups About Pesticides and Health Care*. Washington State Department of Health (unpublished)

<sup>24</sup> *Summary Results of Yakima Farmworker Focus Groups about Pesticides and Health Care*, Washington State Department of Health, September 22, 2003.



The California experience confirms that monitoring can effectively combat serious poisonings. Results from a 1999 survey of California physicians providing cholinesterase-monitoring services indicate that the program is effective in identifying and removing workers from over-exposure.<sup>25</sup> Of the 101 physicians who responded to the 1999 survey, 68% reported that they had recommended that employees be removed from exposure to cholinesterase inhibiting pesticides due to falling below trigger threshold for ChE levels. The physician respondents indicated that medical monitoring was effective in preventing illness. The survey results establish that when monitoring detects ChE inhibition, workers can be removed from exposure before becoming clinically ill and work place deficiencies can then be corrected.

The rule also will prevent such illnesses by identifying depressions even before removal is necessary. The resulting investigation of work practices should result in a correction of any identified problems without either medical removal or medical treatment being required.

### **Greater Certainty about Frequency of Pesticide Over-Exposure**

One of the clear and obvious benefits of the rule is that the relative uncertainty regarding the number of employees being poisoned can be addressed by a comprehensive medical monitoring rule. After just a year or two of tests have been conducted, the rule will provide relatively clear answers to the question “how many pesticide handlers are experiencing depressed cholinesterase levels?” If the level is dramatically higher than L&I now believes, further rulemaking may be appropriate. If the level is dramatically lower, the rule and its requirements can be adjusted to reflect that information. In this way, one of the clear benefits of the rule is increased certainty about the degree to which pesticide handlers are being poisoned by covered pesticides. This benefit will accrue to employees, employers and L&I alike. In addition to the immediate benefits of information, more reliable data will allow greater precision in future discussions about the degree of pesticide poisoning and cholinesterase depression. This, in turn, will inform future activities by researchers and policy-makers attempting to better understand the relationships between pesticide use and illness.

In addition to the benefits within Washington workplaces that would result from greater certainty regarding these issues, the record suggests that there will be at least some modest benefits in other jurisdictions as a result of the medical monitoring requirements in the rule, coupled with effective data capture and analysis that is not available elsewhere in the country.

The rule also will enable the development of a database allowing the scientific review of historic monitoring and cholinesterase depression data, as well as the tracking of populations of exposed workers, including those suffering from significant cholinesterase depression. This, in turn, will allow greater certainty about the long-term effects of over-exposure and of cholinesterase depression.

### **Prevention of Illness Through Greater Compliance with Pesticide Worker Protection Standard**

Traditionally, monitoring requirements supplement other regulatory provisions. Medical monitoring is one way to determine whether appropriate work practices are being used and personal protective equipment (PPE) is being provided and worn. The EPA estimated that full compliance with the Worker Protection Standard (WPS) would prevent 80 percent of the acute pesticide poisoning cases among pesticide handlers.<sup>26</sup> However, this result – which protects

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<sup>25</sup> California Environmental Protection Agency (1999). Results of a Survey regarding Certification and Training for Physicians Providing Medical Supervision for California Pesticide Mixer/Loader/Applicators. California Office of Environmental Health Hazard Assessment.

<sup>26</sup> *Regulatory Impact Analysis*, EPA, p. V-31.

workers even before the low-level depressions described above occur – can be achieved only if the requirements of the standard are followed on the job site.

A National Academy of Science analysis of the issue stated “The major criticism of the 1992 WPS...has been lack of compliance.”<sup>27</sup> The analysis goes on to say:

The current system has a number of problems. First, it is generally more difficult to monitor activities on a large farm than a factory or other circumscribed area. Second, most enforcement efforts are responses to complaints, so enforcement activities do not give a quantitative indication of general compliance. Third, the agencies responsible for compliance reporting can have political conflicts of interest. Fourth, it is difficult for workers and even medical personnel to diagnose pesticide poisonings (EPA 1998).<sup>28</sup>

The analysis also identified as one important goal to increase benefits and decrease risks by increasing “...the ability and motivation of agricultural workers to lessen their exposure to potentially harmful chemicals and refine worker-protection regulations and enforce compliance with them.”<sup>29</sup>

California has had a cholinesterase-monitoring program in place for agricultural pesticide handlers since 1974.<sup>30</sup> California program staff have identified several benefits of routine cholinesterase monitoring. Monitoring can identify workers with small but significant ChE depressions, triggering a review of work practices and employers’ safety programs to find the source of exposure and make necessary corrections. Physicians may remove workers with depressed ChE levels from further exposure, thereby preventing illness. Participation in a cholinesterase monitoring increases worker and employer awareness of the toxicity of chemicals handled. By reducing over-exposure to cholinesterase-inhibiting pesticides, cholinesterase monitoring may protect workers from developing possible long-term effects.<sup>31</sup>

Comments from stakeholders (both supporters and opponents of the rule) confirm the importance of enforcing the use of PPE among the workforce in order to avoid poisoning. Although it cannot be readily quantified, one of the benefits of the rule will be increased compliance with the existing WPS requirements by employers and employees. This would occur both in relation to specific instances of over-exposure (and resulting depression) and as a result of greater awareness of the need to ensure workplace safety rules are followed.

Employers and their employees will benefit from increased worker productivity when workers are healthy. In addition to the debilitating effects of the immediate symptoms of poisoning by covered pesticides, the record includes suggestions that worker productivity will benefit from reduced long-term exposure as well.<sup>32</sup> The benefits to workers from the identification of problems with the application of existing PPE, work practice and engineering control requirements will not be limited to those pesticide handlers who suffer pesticide poisonings identified by the rule, but also will benefit other workers, including those who may be handling pesticides below the rule’s thresholds and those workers who may not be handling pesticides at all but may be exposed as a result of breakdowns in workplace health protection.

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<sup>27</sup> National Academy of Science (2000), *The Future Role of Pesticides in US Agriculture*. p. 131.

<sup>28</sup> Ibid.

<sup>29</sup> Ibid. p. 4.

<sup>30</sup> Ames, R.G., Brown, S.K., Mengle, D.C., Kahn, E., Stratton, J.W., & Jackson, R.J. (1989) “Protecting Agricultural Applicators From Over-Exposure to Cholinesterase-Inhibiting Pesticides: Perspectives from the California Program,” *Journal of Occupational Medicine* vol. 39, 85-92.

<sup>31</sup> Ibid.

<sup>32</sup> See, for example, Burton, W., *et al.*, “The Role of Health Risk Factors and Disease on Worker Productivity,” *Journal of Occupational Environmental Medicine* 10 (1999); and Moses, Marion, “Pesticide-Related Health Problems and Farmworkers,” 37 *American Association Occupational Health Nurses* 3 (1989).

### Other Benefits

Identification of Existing, But Undiagnosed, Workers Compensation Claims. Currently, without a proper diagnosis, a poisoned worker misses work and is not paid for medical costs or lost wages from undiagnosed pesticide poisoning. After the rule takes effect, these pesticide handlers are likely to be ‘brought into’ the workers compensation system as a result of the ongoing monitoring program. The rule will therefore help to accomplish an important goal of the workers compensation system by compensating workers for occupationally caused illnesses, in accordance with existing legal mandates found in the Industrial Insurance Act.<sup>33,34</sup>

Identification of the Need to Improve WPS Requirements. In addition to identifying problems with the application or enforcement of existing requirements, the rule will enable L&I and other agencies, as well as employers and employees, to identify any existing PPE, work practice and engineering control requirements that are not sufficient to protect pesticide handlers from dangerous exposures.

Protection of Worker and Family Health. Protection of worker health, even from uncertain risks, is itself a preeminent benefit under WISHA.<sup>35</sup> By decreasing the risk of uncontrolled exposures to workers due to inappropriate PPE or inadequate decontamination the rule will also decrease unintended exposures to workers’ families, including children. Evidence suggests children may have a higher sensitivity to health effects from pesticides. In any case, the rule should at least make sure that workers are better informed about those exposures, which remain a meaningful issue in the homes of agricultural workers.<sup>36</sup>

Economic and Social Impacts on Handlers and Their Families. Pesticide poisoning has impacts beyond the physical symptoms and illnesses that may be suffered by handlers. Missed work generally means missed or lowered paychecks for handlers, since many of these workers do not have sick-leave benefits. This can in turn result in additional financial stress on their families. Likewise, the symptoms of chronic overexposure to pesticides can add stress to families as well as to workers. The diminished ability to perform family and social roles that result from illness – or fear of illness – cannot readily be quantified but are real in their impacts on the lives of workers and their families.

Incentives for Closed Systems. The rule has an incentive effect for employers to increase the use of closed systems for pesticide mixing/application. The benefit from an increased use of closed systems would be a reduction of accidental splash/spill exposures and medical removals partly or wholly due to these types of exposures.

Evaluation of Relative Pesticide Toxicities. Linking depressed cholinesterase levels with the specific pesticides could allow health and safety experts to identify the more toxic or absorbable covered pesticides that are causing these depressions. This could lead to pesticide substitution

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<sup>33</sup> Title 51, Revised Code of Washington.

<sup>34</sup> It can be suggested that this “benefit” is offset by the “cost” to employers and others of paying for workers compensation claims that are occurring but that go unreported. Clearly, the benefit of fulfilling the legislative intent of Title 51 RCW exceeds the costs of paying for claims that should be reported but are currently unrecognized. The question of such “transfers” comes up in other contexts as well – for example, it could be argued that the costs to employers of complying with the rule by paying doctors, laboratories and workers are offset by the benefit to the doctors, laboratories and workers of receiving those payments. However, the department does not consider it appropriate to consider the benefit to such recipients of mandated compliance costs as offsetting the costs of the rule.

<sup>35</sup> This is discussed in greater detail in the analysis beginning on page 23.

<sup>36</sup> Thompson, Beti, PhD, *et al*, “Pesticide Take-Home Pathway among Children of Agricultural Workers,” *Journal of Occupational Environmental Medicine*, January 2003, pp. 42-52.

and possibly restricting the use of these pesticides, resulting ultimately in fewer adverse health effects.

Increased Farm Worker Access to the Healthcare System. An incidental benefit of the rule will be an increase in farmworker access to the healthcare system by establishing a relationship with a medical provider. This relationship should increase the likelihood that workers will report potential pesticide exposures and pesticide-related illnesses to their doctors, even if the pesticides involved are not covered by the rule. While it is not the intent or the purpose of the rule, other medical problems of farm workers could be discovered incidentally to the initial medical consultation of the pesticide handler and the health care provider.

Greater Awareness by Other Workers of Potential Exposures. Medical monitoring will make additional information available, both in the workplace and in the scientific and medical community, that will allow former workers to become aware of the possibility of prior exposures and that will allow the identification of exposures and potential exposures by job task.

Decrease in Pesticide Use. Although the record suggests that pesticide use might be affected, L&I does not consider this potential shift to be either a cost or a benefit of the rule. The rule itself does not in any way restrict the use of covered pesticides, provided the monitoring requirements are met. Although there may be some shift in use patterns, the record is inconclusive about whether such a shift would represent, on balance, a benefit or a cost. Therefore, L&I has treated the impact of any such shift as being an essentially neutral one.

### **Section 3: Probable Costs of the Rule**

Because data is available from an employer survey and other sources, it is possible to quantify the probable costs of the rule.

For each set of employer costs resulting from the rule, L&I calculated costs using the data from the survey and other sources (as noted in the text), which L&I believes represent the best available data. In developing these costs, L&I used a set of reasonable assumptions to generate a most probable central value. In each case, alternative assumptions that would provide both a low and a high estimate are also provided.<sup>37</sup> These assumptions are described in detail below and summarized in Table 4 on page 23.

#### **Employer Survey**

The department designed a survey instrument to help determine the probable compliance costs of the rule. The Washington State Department of Agriculture (WSDA) was consulted to determine the types of crops where use of covered pesticides was most common in order to focus the survey on selectively targeted industry sectors. The firms in each sector were identified from L&I's workers' compensation database using a random sample in each of the affected industries. The industries targeted in the survey, with their associated standard industrial classification (SIC), are as follows:

- SIC 0134 All potatoes except yams.
- SIC 0139 Field crops: hay, alfalfa, hops, mint, etc.
- SIC 0171 All berry crops.
- SIC 0172 Grapes.
- SIC 0175 Deciduous fruit trees.
- SIC 0711 Only professional pesticide applicators contacted.
- SIC 0721 Only soil fumigators in this SIC contacted.
- SIC 0811 Timber tracts, Christmas tree growing, tree farms.

The following sectors were among those not targeted in the survey because use of covered pesticides was expected to be minimal.<sup>38</sup>

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<sup>37</sup> The analysis of the compliance costs contained in this CBA is similar to the methodology contained in the Small Business Economic Impact Statement (SBEIS) filed with the proposed rule. The main difference is the statistical treatment of certain survey responses on how many employees are handling covered pesticides at the different exposure durations of 30-60 hours, 61-100 hours and over 100 hours. In the SBEIS, those firms' responses of 'not known' were coded as 'na' but were erroneously assigned a zero value in various calculations of averages and sums. The correction increases the average number of baseline and periodic testing costs for large firm orchardists. The impact on the commercial applicator sector is minute.

This document also corrects an error in the SBEIS that overstated the rate of medical removal by applying the percentage to the number of tests, rather than to the number of employees as intended.

These corrections, and several other minor adjustments to the statistical analysis, did not have a major effect on the calculation of the costs or on the comparison of small and larger businesses for potential disproportionate impact.

<sup>38</sup> In addition to the SIC codes mentioned here Chapter 296-307 WAC also specifically applies to the following SIC codes, although use of the covered pesticides in these industrial sectors is likely to be either nonexistent or infrequent: 0133, 0173, 0179, 0181, 0182, 0191, 0211, 0212, 0213, 0214, 0219, 0241, 0251, 0252, 0253, 0254, 0259, 0271, 0272, 0273, 0279, 0291, 0711, 0722, 0751, 0761, 0831, 0851.

- SIC 0111 Wheat.
- SIC 0115 Corn.
- SIC 0119 Grains not elsewhere classified.
- SIC 0161 Vegetables.

Due either to misclassification when the employer's original account was created or to a change in crop composition after the account was established, some firms in the above industries were included in the survey. Furthermore, some of those firms reported that they used covered pesticides at levels that would trigger monitoring by the rule. Based on the information provided, their SICs were corrected, and they were included in the analysis.

This survey data was organized into the following sectors for analysis:

- SIC 0721 (commercial applicators) was analyzed separately because of its unique characteristic of contracting for other sectors.
- SIC 0175 (orchards) was analyzed separately because of its unique characteristics of being the heaviest user of pesticides in agriculture.
- SICs 0111, 0115, 0119, 0134, 0139, 0161, 0171, 0172, and 0811 ('other growers') were analyzed together as they were found to be less frequent users of pesticides than the orchard industry. Furthermore, due to the low number of respondents in these sectors, greater statistical reliability is achieved by aggregation.

The Gilmore Group, based in Seattle, Washington, conducted a phone survey in February and March 2003 using lists of large and small agricultural businesses by SIC provided by the department. The Gilmore Group randomly selected specified numbers of businesses in each subcategory.

The *key* questions asked of the survey participants were as follows:

- 1) Do you use pesticides in your business?
- 2) What are the 4 main crops grown by your business and their associated acreages (growers only)?
- 3) In a typical growing season, how many handlers do you have that handle these pesticides?
- 4) What is the average hourly wage of these handlers?
- 5) Positive respondents to the question 3 were asked for the number of handlers handling pesticides for each month of the year at the following levels of exposure durations:
  - 30 to 60 hours
  - 61 to 100 hours
  - 101 or more hours
- 6) Do you currently conduct cholinesterase monitoring of your handlers that handle pesticides?
- 7) What were the results of the monitoring?
- 8) Are reassignment positions available for handlers removed from pesticide handling for up to 60 days?
- 9) How far is your business from the nearest medical clinic or facility that you use?

- 10) To determine the probable firm response to the proposed rule by changing work assignment or making other modifications to fall below the monitoring threshold, the survey asked the following question: If the rule requiring mandatory cholinesterase monitoring of handlers is eventually adopted, please select the response or a combination of the following responses for how you plan on complying with the rule. Please listen to all the choices before answering.
- a. Discontinue the use of these pesticides altogether on my crops.
  - b. Have owners or family members apply the pesticides.
  - c. Contract with a professional pesticide applicator and let them deal with the monitoring requirements.
  - d. Use regular handlers to handle the pesticides but have them handle the pesticides for time periods below the threshold that would trigger the medical monitoring requirement.
  - e. Use regular handlers over time periods above the threshold that would trigger the medical monitoring requirement and follow the medical monitoring requirements of the rule.
  - f. Other, please specify \_\_\_\_\_

**Number of Employees Affected.**

One important assumption for both first and second year costs involves the number of handlers affected by the medical monitoring requirements. A number of factors must be considered:

First-year coverage. When the phone survey was designed and executed, the medical monitoring thresholds to be included in the proposed rule had not been determined. Therefore data on monthly exposures in the following ranges were queried in the survey:

- 30 to 60 hours;
- 61 to 100 hours;
- and over 100 hours.

In addition, the survey responses allow for a conservative estimate for the number of employees who handle pesticides but never exceed the 30-hour threshold.

The rule covers employees at 50 or more exposure hours in the first year and 30 or more exposure hours during the second year. While the survey provides information directly applicable to the second year threshold, the first year costs must be extrapolated from the survey results based on reasonable assumptions about the number of employees who handle pesticides more than 50 but fewer than 60 hours. L&I used the available data to develop statistical models (one each for small businesses and the largest 10 percent of businesses). This allowed L&I to estimate the distribution in each industry sector in 10-hour increments, providing a central value for the 50 to 60 hour range. The low estimate was calculated at 75 percent of the central value, while the high estimate was calculated at 125 percent of the central value. This assumption has no effect on costs from the second year forward.

Inconsistent Survey Responses. Slightly fewer than 10 percent of the respondents gave inconsistent responses to the questions: "In a typical growing season, how many handlers do you have that handle these pesticides?" and "Number of employees handling pesticides 30-60 hours (61-100 or 100+) during (each) month." For example, if a firm reported a total of 2 handlers, but then later said that 2 handlers worked at both the 30-60 and 61-100 exposure levels in July, this would result in a total of 4 handlers in July, twice the total number of handlers the firm

reported overall. In this example, L&I excluded the 2 users at the 30 to 60-hour interval, leaving 2 handlers at the 61 to 100 level as the most likely number. The alternative to this would be to discard the inconsistent data, which is inappropriate given the correctable nature of the probable error and the effect discarding such data would have on the ability to evaluate relative costs in the Commercial Applicator sector (where one of the three larger employers responding to the survey gave inconsistent responses).

Impact of reduced need for “periodic testing”. The rule provides reduced requirements when handlers are using only carbamates. It may also reduce requirements when handlers use closed systems to mix and load. In such cases, the need for periodic testing (beyond the baseline) could be reduced or eliminated. However, L&I does not have reliable data on the degree to which either situation occurs, and even less ability to determine the degree to which it will occur when the rule is in place. Therefore, the current analysis assumes that all handling hours will be covered by the periodic testing requirement, which is likely to overstate the cost of the rule to at least some degree.

Impact in Shift of Pesticide Application Practices. Similarly, one of the questions on the survey asked about shifts in behavior or work assignment that would reduce the number of handlers affected by the medical monitoring requirements in the rule. Although such a shift was predicted by a meaningful number of respondents (see Table 2), this analysis does not reflect the resulting reduction in employer costs. Instead, it treats the cost of the shift as essentially identical to the cost of complying without any change in work assignments. The benefit of reducing risk by distributing the exposures, suggested by some respondents, is reflected in the benefits section of this determination.

This clearly overstates employer costs. Employers would not be likely to change unless they believed that the net cost of such a change would be lower than the cost of complying without such changes. However, no data is available to allow L&I to estimate the cost of the alternatives chosen by the respondents, making the conservative approach described above appropriate.

**Table 2: Reported Change in Pesticide Application Practices (Survey Response)\***

	Discontinue Pesticide Use	Owner or Family Will Apply	Use Professional Applicator	Keep Hours Below Threshold	No Change
Professional Applicators					
Small Business	0%	52%	0%	62%	7%
Largest 10 Percent	0%	0%	0%	100%	33%
Orchardists					
Small Business	0%	54%	0%	49%	5%
Largest 10 Percent	0%	4%	0%	61%	21%
Other Growers					
Small Business	5%	5%	43%	33%	10%
Largest 10 Percent	8%	0%	8%	75%	17%

\*Totals may exceed 100 percent because respondents were allowed to select more than one response. For example, one larger professional applicator indicated that it would make no change but would *continue* to keep hours below the threshold.



Calculations of the number of handlers affected by the medical monitoring thresholds each month are discussed in “notes on calculations” on page 22.

### **Cost of Wages and Benefits**

At several points, estimated wage costs are used. Estimated handler wages were calculated using employer responses to the survey to generate average wage estimates.

Estimated wage costs for managers, supervisors, and administrative/clerical staff were used to develop costs of recordkeeping and training.

In all cases, wage calculations have been adjusted to reflect the following additions to the basic wage.<sup>39</sup>

- Federal Social Security/Medicare 7.65%
- State Unemployment Insurance 3.61%
- Federal Unemployment Insurance 0.80%
- State Workers Compensation 4.54%

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Total Adjustment for Benefits	16.60%
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Based on the information available and the nature of the employment relationships, the analysis assumes that there will be no additional benefit costs (for example, resulting from employer-provided medical insurance or pension benefits).

**Table 3: Average Hourly Wage and Benefit Estimates**

	Small Business	Larger 10 Percent
Professional Applicators	\$14.92	\$14.21
Orchardists	\$10.13	\$9.71
Other Growers	\$10.56	\$11.83
Manager	\$34.80	
Supervisor	\$23.20	
Administrative/Clerical	\$13.92	

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<sup>39</sup> The estimate was not adjusted to reflect slight variations in occupation rates or modifications based on employer-specific experience; the workers' compensation premium reflects only the employer cost, and reflects an average estimated cost. The average employer pays somewhat less than the base rate, and a significant portion of the premium can be deducted from employees' paychecks. The estimate has been increased 22 percent from the SBEIS to reflect proposed industrial insurance premium rates for orchards (although no decision had been made on those proposed rates at the time this analysis was prepared).

### **Recordkeeping Costs.**

The central estimate for the recordkeeping cost per firm is the sum of three components:

- 1) initial recordkeeping setup costs, using materials generated by L&I and estimated by L&I at 30 minutes of a field foreman's time per business;
- 2) costs of recording the hours for pesticide handlers each month, estimated at 15 minutes per handler month recorded; and
- 3) minimal costs for recordkeeping materials supplies.

The assumptions for the central, high, and low estimates are as follows:

- In the central estimate, the wage for the field foreman or other senior employee keeping records was estimated at \$20 per hour, plus 16.60 percent in benefits.
- The low estimate assumes that a lower paid administrative or clerical employee keeps the records at an estimated wage of \$12 per hour, plus 16.60 percent in benefits.
- The high estimate assumes that the owner or a manager keeps the records, with an estimated hourly wage of \$30, plus 16.60 percent average cost of benefits (although some of these benefit costs would not necessarily be paid if the records were being kept by the business owner).

### **Training Costs.**

Training costs consist of the sum of four components:

- 1) the cost of the trainer setting up the training;
- 2) the cost of the trainer to conduct the training;
- 3) the cost of the handler's time; and
- 4) costs for training materials.

The analysis assumes that the field foreman (or equivalent) will be the trainer, and that he or she will spend one hour setting up the training and one half hour conducting it. The employees will spend one-half hour each attending the training (handler wages are based on responses to the survey and are reflected in Table 3). Training material costs are estimated at \$10 per employer.

- The central estimate assumes that at least half (50 percent) of these employees will return in the second year, based on consistent descriptions of these workers in stakeholder and public meetings as being "highly valued" and "stable" members of the employer's workforce. This will reduce second year training costs accordingly (and would also mean that costs in future years would be somewhat lower than those in the second year). It also assumes that an employer's handlers can typically be trained as a group.
- The low estimate assumes that 75 percent of employees will be returning in the second year.
- The high estimate assumes that only 25 percent of employees will return in the second year.

**Baseline Testing Costs.**

The baseline testing costs are the sum of the following:

- 1) time spent in initial identification and selection of the medical provider;
- 2) clinical fees (including an initial fee for first clinic visit by each handler, even if he or she subsequently declines testing);
- 3) laboratory analysis costs;
- 4) cost of handler wages;
- 5) mileage costs.

The costs will also be affected by the employee participation rate and the number of employees who return to the employer in the second year.

Employee Participation. A certain number of employees can be expected to decline participation in the medical monitoring after discussing it with the medical provider. Employees who do not participate will eliminate the laboratory costs and the costs of clinical evaluation of the test.

- The central estimate assumes that the employee participation rate will be 85 percent, based on consistent advice from stakeholders anticipating a relatively high non-participation rate.
- The low estimate assumes a 75 percent employee participation rate.
- The high estimate assumes a 95 percent employee participation rate.

Returning Employees. Many employees will return to the same employer in later years. Such employees will not repeat the initial clinic visit in the second year (or in subsequent years).

- The central cost estimate assumes that 50 percent of the employees who receive a baseline in the first year will return to the same employer (and medical provider) in the second year.
- The low estimate assumes that 75 percent of handlers will return in the second year.
- The high estimate assumes that only 25 percent of handlers will return in the second year.

Provider Costs. Medical provider costs have been developed based on a determination of the time necessary to identify and select a provider, as well as the provider's clinical fees. Based on information from medical providers, the analysis includes an estimated \$112 initial clinic fee for the first clinic visit for each employee, and an estimated \$38 clinical evaluation fee for each test.

- The central estimate assumes one hour of a manager's time would be necessary to identify and establish the relationship with a medical provider.
- The low estimate assumes that employers will be able to select from a meaningful number of medical providers identified and trained by L&I, reducing the manager's time in initial selection to ½ hour.
- The high estimate assumes that selection will take one hour of a manager's time.

Laboratory Costs. Estimated initial baseline test costs had been developed from data the department has collected from clinics and from employer responses to the survey. However, those numbers have been adjusted in this final analysis to reflect actual prices offered by the Public Health Laboratory (PHL) at the Washington Department of Health (which more than confirmed L&I's earlier assumption that it would be able to establish a new benchmark rate using the first-year costs).

- The central estimate reflects costs quoted to L&I by the PHL of \$27 for the first year and an estimated \$20 for the second year (based on the increase in volume). In each year, a \$10 clinical handling fee is also included in the analysis.
- The low estimate assumes that the second year laboratory analysis rate will be \$18 (the rate quoted by the PHL, which does not take into account individual billing costs), with a \$10 clinical handling fee.
- The high estimate assumes that laboratory analysis costs in the second year will increase to the original estimate of \$40).

Wage and Travel Costs. Mileage (reimbursed at \$.34 per mile) and employee wages for all three estimates are based on responses to the employer survey.

**Periodic Testing Costs.**

The periodic testing costs are the sum of the following:

- 1) clinical fees;
- 2) laboratory analysis costs;
- 3) cost of handler wages
- 4) mileage.

The costs also will be affected by employee participation rates.

Employee Participation. Employee participation assumptions are explained under the baseline testing, above. Employees who do not participate will eliminate the costs of periodic testing.

Provider Costs. An estimated \$38 clinical evaluation fee would apply for each test.

Laboratory Costs. Estimated periodic test laboratory costs are identical to those explained under baseline testing, above.

Wage and Travel Costs. Mileage (reimbursed at \$.34 per mile) and employee wages for all three estimates are based on responses to the employer survey.

Frequency of Monitoring. In all cases, the frequency of periodic monitoring is based on the monthly data reported by the employer survey. As discussed on page 16, it has not been adjusted to reflect the reported changes in behavior or work assignment by employers to reduce the number of handlers reaching the threshold level.

**Work Practice Investigation.**

While the rule requires work practice investigations for handlers that have certain depressed cholinesterase levels found by periodic monitoring, this would not impose more than minimal costs on businesses. Employers are already required to be aware of hazardous conditions in

their workplaces, and the monitoring results will actually provide them better information to meet their current obligations to identify and correct hazards.

Therefore, the costs of the specific requirement to analyze work practices following an identified depression will be minimal and are not otherwise reflected here.

### **Medical Removal Costs.**

The cost of medical removal is based on the time the employee is reassigned or removed from work completely, multiplied by the average wage and benefits. In order to calculate the cost of medical removal, it is necessary to estimate how frequently depressions requiring such removal will occur. It is also necessary to determine how frequently employees will be removed rather than reassigned to new duties. In addition, it is necessary to determine the “cost” of reassignment (as opposed to removal from useful work). In each case, it is necessary to determine how long removal will last when it does occur.

Frequency of Medical Removal. The California's Department of Pesticide Regulation found that 4.8 percent of workers tested had ChE values below the threshold level requiring removal.<sup>40</sup> The removal thresholds used in California at that time were 10% lower than those in the new Washington rule, so removal rates under the new rule might be slightly higher.<sup>41</sup> However, the group did not necessarily represent exposures addressed by this rule, particularly in the first year when the threshold for monitoring will be triggered by 50 hours of covered activity, rather than 30.<sup>42</sup> In addition, the average California handler is likely to be exposed for more months, suggesting the Washington removal rate would be slightly lower based on lower cumulative exposures.

The seven Washington growers and one Washington applicator who reported in the survey that they conduct voluntary ChE testing reported no depressed ChE levels. This could have provided a basis for an even lower estimate of removal frequency. However, the details of this monitoring were not reported (number of handlers monitored, testing procedures and exposure durations triggering monitoring). Therefore, this information, while suggestive, cannot be assumed to be representative of the populations monitored by the rule.

L&I reviewed this information and considered stakeholder comments about the differences between California and Washington application patterns, the increased use of closed systems, reductions in the use of the most hazardous pesticides, the more stringent worker protection requirements in place today compared to 1989, and the employer incentive to avoid the cost of removal created by the medical removal protection requirement itself. Based on these factors, L&I has concluded that the 4.8 percent removal rate represents the high end of the likely range and that the most likely outcome can be expected to be lower.

- The central estimate assumes a 3.0 percent removal rate.

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<sup>40</sup> Ames, *et al*, “Cholinesterase Activity Depression Among California Agricultural Pesticide Applicators,” *American Journal of Industrial Medicine*, 1989)

<sup>41</sup> This expectation was confirmed by Ames unpublished analysis of removal rates under the more protective thresholds, which suggested a 7.5 percent removal rate.

<sup>42</sup> It is not entirely clear what the effect of the higher hourly threshold would be on the average removal rate. While workers at a higher threshold obviously have a greater potential for exposure based on the level of pesticide use, it is also possible to argue that they are more likely to be higher skilled workers and may be more proficient in their work practices. Based on the data available, the department has reached no conclusion as to whether the average removal rate will be higher, lower or the same at the 50-hour threshold as at the 30-hour threshold. For this reason, the same range of removal rates is used for the first year and for all subsequent years.

- The low estimate assumes a 1.2 percent removal rate.
- The high estimate assumes a 4.8 percent removal rate.

Additional Medical Tests. In all scenarios, the analysis assumes that two additional periodic tests will be required before the employee is restored to full work status: one test to confirm the depression, and another test for return-to-work approval

Wage Costs. Employee average wages are based on employer survey information, calculated against an estimated 55-hour work week, which is based on stakeholder information about the length of the work week during peak seasons. In addition, the employer survey provides an estimate of the availability of jobs into which employees can be reassigned.

- For the central estimate, L&I assumes that when reassignment occurs another employee will be assigned the duties of the pesticide handler. The estimate also assumes the reported reassignment jobs have full value to the employer, so that the cost to the employer will be accurately reflected by an estimated \$2 per hour in additional wages to pay another worker to take on the higher level duties normally performed by the pesticide handler. The final analysis includes an additional \$2 per hour in additional wages to reflect lost productivity due to training needs and related costs when replacement occurs.
- The central estimate also assumes that employees for whom reassignment jobs are not readily available will be removed entirely, requiring employers to pay their wages and benefits without receiving any offsetting reduction in other costs.
- The low estimate makes the same assumptions about the cost of reassignment but also assumes that many employers who do not have reassignment jobs readily available will find reassignment jobs to avoid absorbing the complete cost of medical removal. Based on this assumption, and recognizing that such jobs are not likely to have full value to the employer, the low estimate reduces the cost of removing those employees by 25 percent.
- The high estimate assumes that the reported reassignment jobs have only minimal value to the employer and therefore calculates 75 percent of the reassigned employee's wages and benefits as a cost of compliance with the rule. It also assumes that employees for whom reassignment jobs are not readily available will be removed entirely.

Duration of Removal. The only clear indication for the estimated length of time for a medical removal period that could be found in the medical literature is an average of 3.5 weeks.<sup>43</sup>

In this study the results of data on 100 workers who had ongoing cholinesterase monitoring were evaluated.<sup>44</sup> Twenty-four workers were temporarily removed from exposure due to cholinesterase depression of greater than or equal to 40% for plasma cholinesterase or greater than or equal to 30% for RBC cholinesterase. These workers were returned to handling duties when their cholinesterase levels returned to within 20% of the baseline. The shortest time an employee was removed from exposure was 1 day. The longest removal period was 119 days. Removing these outliers from the calculation, it is reasonable to expect a 22-day average removal period. This 22-day removal has been used for all scenarios.

Table 4 on page 23 summarizes the various assumptions described in the preceding pages.

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<sup>43</sup> Lessenger and Fillmore, "A Cholinesterase Testing Program for Pesticide Applicators," *Journal of Occupational Medicine*, 1993.

<sup>44</sup> The 24 percent does not reflect anticipated removal rate, because the sample was not representative; nonetheless, the data is useful in estimating the recovery period once a depression has occurred.

**Table 4: Summary of Parameters of High-Central-Low Estimates**

	High	Central	Low
Recordkeeper Wage	\$30 plus 16.60%	\$20 plus 16.60%	\$12 plus 16.60%
Trainer Wage	\$30 plus 16.60%	\$20 plus 16.60%	\$20 plus 16.60%
Handlers Returning in 2nd Year	25%	50%	75%
Handler Participation in Medical Tests	95%	85%	75%
Laboratory Costs (1st Year)	\$70	\$55	\$55
Laboratory Costs (2nd Year)	\$70	\$60	\$55
Manager Time to Select Provider	1 hour	1 hour	½ hour
Medical Removal Rate	4.8%	3.0%	1.2%
Medical Removal (w/o Reassignment)	Wages plus 16.60%	Wages plus 16.60%	75% of wages plus 16.60%
Medical Removal (with Reassignment)	75% of wages plus 16.60%	\$4 plus 16.60%	\$4 plus 16.60%
Handlers in 50- to 60-hour Group (1st Year)	125% of Central Estimate	Estimated Distribution	75% of Central Estimate

**Notes on Calculations**

**Average number of employee months of pesticide handling above threshold.**

This was determined by aggregating the number of handlers monitored during any month of the year (see Table 5). For example, if a firm has six handlers exposed at the 30-hour level in one month, then this results in 6 employee months of monitoring. If this happens in each of three months then this results in 18 employee months of exposure. This is calculated for 30-60 and 60+ levels of exposure for small and large firms and by sector. This statistic is used to calculate the number of periodic tests for average size firms and to estimate the number of medically removed handlers (the use of the 60+ data to estimate exposures at the 50+ threshold in the first year is described in the footnote on page 13).

**Table 5: Average Handler Months Above Monitoring Thresholds**  
(Average per Employer with Employees Handling Covered Pesticides at Any Level)

	First Year		Second Year	
	<u>Small</u>	<u>Large</u>	<u>Small</u>	<u>Large</u>
Professional Applicators	2.91	17.81	4.10	22.00
Orchardists	0.97	6.99	4.08	18.96
Other Growers	0.32	1.24	0.68	3.33

L&I does not have survey or other direct data showing pesticide handling on a monthly basis for those firms not expected to exceed the 30-hour threshold (which is relevant in estimating the record-keeping costs. However, the analysis assumes a monthly distribution similar to that found in the 30 to 60 hour range.

**Estimates of Total Industry Compliance Costs**

The majority of these costs are the result of medical testing fees, clinic evaluation fees, and doctors visits. There are two levels of exposure to covered pesticides contained in the rule. In the first year, exposures of over 50 hours in a 30-day period require the medical monitoring, and in the second and subsequent years, the threshold is lowered to 30 hours. Costs were estimated for low, central and high scenarios (described in more detail in the attachments to this analysis). The appropriation of \$378 thousand by the Washington State legislature in the 2003 regular session for laboratory-testing and medical fees would reduce the cost impact on industry and is in effect a shift in costs but not an overall reduction of actual costs; it is therefore not reflected in this analysis. The cost ranges for the first year and second years of the rule are in the following table.<sup>45</sup>

<b>Table 6: Estimated Compliance Costs</b>			
	<b>Central</b>	<b>High</b>	<b>Low</b>
<b>First Year</b>	\$848,490	\$1,159,349	\$688,668
<b>Second Year</b>	\$1,274,487	\$1,730,364	\$1,096,165

The only qualitative cost suggested in the record related to the invasive nature of the medical test and the need to avoid imposing such a test on pesticide handlers. However, since the test can be declined by the worker, the department has concluded that its availability cannot accurately be considered a cost to the worker.

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<sup>45</sup> Throughout this analysis, dollar values for future years are presented in current dollars, without adjustment or discounting.



#### **IV. BENEFIT-COST DETERMINATION**

This assessment has been prepared by the Department of Labor and Industries (L&I) in compliance with the Administrative Procedure Act (APA), which requires that an agency adopting a “significant legislative rule”<sup>46</sup> must “[d]etermine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented.”<sup>47</sup>

To make the required determination, L&I has first considered the criteria for comparing the probable benefits to the probable costs.

##### **The Statutory Mandate**

In this case, the statutory provision of the Washington Industrial Safety and Health Act (WISHA) being implemented requires L&I to adopt rules that “[p]rovide for the promulgation of health and safety standards and the control of conditions in all work places concerning gases, vapors, dust, or other airborne particles, toxic materials, or harmful physical agents which shall set a standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life; any such standards shall require where appropriate the use of protective devices or equipment and for monitoring or measuring any such gases, vapors, dust, or other airborne particles, toxic materials, or harmful physical agents.”<sup>48</sup>

This provision, and the language in the federal Occupational Safety and Health Act (OSHA) on which it is based, have been addressed several times by state and federal courts. The case that prompted this rulemaking, *Rios v. L&I*, addresses the context in which the benefit-cost determination must be made. In *Rios*, the Washington Supreme Court reviewed the record and concluded by a 7-2 margin that

Because the Department had already invested its resources in studying cholinesterase-inhibiting pesticides and because the report of its own team of technical experts had, in light of the most current research, deemed a monitoring program both necessary and doable, the Department’s 1997 denial of the pesticide handlers’ request was ‘unreasonable and taken without regard to the attending facts or circumstances.’ Hillis, 131 Wn.2d at 383. Consequently, in failing to act on the request for rulemaking, the Department violated RCW 49.17.050(4), the requirement that the Department ‘set a standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health.’<sup>49</sup>

The *Rios* court stopped short of ordering adoption of the rule, instead ordering L&I “to initiate rulemaking on a mandatory cholinesterase monitoring program for agricultural pesticide handlers” and remanded the issue to L&I “for further proceedings *consistent with this opinion*”<sup>50</sup> (emphasis added). In *Rios*, the court clearly did more than simply direct L&I to consider the issue in the context of the formal rulemaking process. It also identified the criteria on which the resulting decision must be based.

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<sup>46</sup> Defined in RCW 34.05.328(5).

<sup>47</sup> RCW 34.05.328(1)(c).

<sup>48</sup> RCW 49.17.050(4).

<sup>49</sup> *Juan Rios and Juan Farias v. Washington Department of Labor and Industries, et al*, Washington State Supreme Court, Docket Number 70294-2.

<sup>50</sup> *Ibid*.

The court's discussion of the statute indicates that L&I *must* give serious consideration to adopting a rule requiring medical monitoring *if* L&I's review of the rulemaking record concludes

- that a significant risk of pesticide poisoning exists,
- that a medical monitoring program is an appropriate method to help reduce that risk, and
- that such a program is technologically and economically feasible.

In light of the statutory mandate articulated by the *Rios* court, L&I must place a pre-eminent value on protection of worker health.

In the *Cotton Dust* case, the United States Supreme Court addressed the parallel Congressional determination:

Congress itself defined the basic relationship between costs and benefits, by placing the "benefit" of worker health above all other considerations save those making attainment of this "benefit" unachievable. Any standard based on a balancing of costs and benefits by the Secretary that strikes a different balance than that struck by Congress would be inconsistent with the command set forth in [the statute].<sup>51</sup>

The court went on to declare that "cost-benefit analysis is not required by the statute because feasibility analysis is."<sup>52</sup> This formulation is similar, if not equivalent, to the *Rios* court opinion that L&I is wrong to withhold action when a health rule would be "both necessary and doable."

Unlike federal OSHA, L&I must comply with a separate statutory mandate to conduct such an analysis. However, it can be argued (and some have so argued in the record of this rulemaking) that the terms of the analysis have been predetermined by the legislative mandate.

### **Comparison of Probable Benefits to Probable Costs**

L&I has concluded that there remains a significant risk to pesticide workers. L&I has concluded that cholinesterase monitoring provides additional and appropriate protection. Further, L&I has concluded that a cholinesterase-monitoring program is both technologically and economically feasible. Taken together, these conclusions require that considerable weight must be given to the benefits discussed earlier in this document.

In balancing the benefits against the costs, L&I has recognized that the limitations of the best available evidence prevent the use of a strictly mathematically model. The APA provides for this situation by explicitly requiring consideration of "qualitative" as well as "quantitative" benefits and costs.

In this case, the costs of employer compliance with the rule can be estimated with some degree of confidence. That estimate, developed initially for the Small Business Economic Impact Statement and adjusted slightly based on the rulemaking record, begins on page 13 of this analysis. The central estimate indicates that the rule will cost roughly \$858 thousand the first year and \$1.27 million each year thereafter.<sup>53</sup> Against this probable cost, the department must weigh a variety of probable benefits, none of which can be quantified with any meaningful precision. Those benefits are discussed beginning on page 6 of this analysis.

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<sup>51</sup> American Textile Mfrs. Inst. v. Donovan, 452 U.S. 490, 506 n.25, 9 OSHA Cases 1913 (1981), 509.

<sup>52</sup> Ibid.

<sup>53</sup> The Legislature appropriated \$378,000 to mitigate medical testing costs. However, that appropriation – which will reduce the cost of the rule *for employers* – does not reduce the overall cost of the rule and is therefore not reflected in this assessment of probable benefits and probable costs.

As noted, one of the primary benefits of a mandatory medical monitoring program is likely to be greater knowledge and certainty about the extent and effect of exposures to organophosphate and N-methyl carbamate pesticides. This benefit will largely be realized during the first two years of the rule's existence.

In comparing the benefits of such knowledge, as well as the other probable benefits of the rule, with the probable costs, L&I has determined that the value of greater certainty about the extent of over-exposure to covered pesticides, and the resulting cholinesterase depressions, should be given considerable weight. And nothing short of a mandatory medical monitoring program is likely to provide anything approaching the certainty that would be provided by the rule.

With the information that will be made available from the first two year's of the rule's existence, L&I can evaluate the continued existence of the rule based on hard data and a more complete awareness of the rule's benefits in the prevention of occupational illness. If, as expected, the rule identifies a meaningful number of workers whose over-exposure to pesticides would not otherwise have come to light, the rule will be in place, or can be modified somewhat based on the information available. If, however, the data indicates that the expected over-exposures do not exist, L&I can take action to significantly modify, or even repeal, the rule. Because the rule explicitly includes such a review provision, any unexpected "imbalance" of the benefits and the costs can be addressed.

Because of the benefits outlined earlier in this analysis, because of the statutory pre-eminence given to the protection of worker health, and because the rule provides a mechanism to adjust its requirements if that becomes necessary based on new and better information, L&I has concluded that the probable benefits of the rule outweigh its probable costs, in each of the three cost scenarios discussed previously. L&I made this determination on a preliminary basis in its draft Benefit-Cost Determination, circulated for public comment ending October 31, 2003. The final determination, reflected by the document, is strengthened by the reduction in estimated compliance costs based on the most current information.